mented with sculptures, executed after models by Schwanthaler—representing 'Bavaria Enthroned,' distributing crowns to different figures—exhibiting on one side, Sculpture, Metal-casting, Coinage, Medalling; and on the other, Architecture, Historical Painting, Genre Painting, Encaustic, and Painting on Glass. At the extremities of the pediment are two lions, and the summit is occupied by a phœnix rising from his own ashes. The building consists of a parallelogram, and contains a vestibole, and seven apartments of different sizes, lighted from the top. Two others, lighted by windows, are intended for paintings on glass; and two corridors of communication, also lighted by windows, the walls of which are intended to receive drawings and other objects of small dimensions. Below the ground floor is a temporary receptacle, in which will be unpacked those articles conveyed from a distance for exhibition; here also is the residence of the keeper and other officers, necessarily inhabiting the building. The whole is roofed in with metal, and over the exhibition-rooms are apartments for the supplementary attendants on occasions of exhibition. The rooms, which vary in length from eight to eleven yards, present an aggregate of 1800 square yards; they are floored with a parquet of oak, which opens so as to admit at once large productions sent for exhibition, having been previously adjusted below as intended to be seen. The interior decoration of these rooms is very simple. Above a wainscot, painted like the doors to imitate walnut wood, the walls are painted with flat colour of a reddish brown or olive green hue, and divided at a certain height by a bandeau supporting pillasters, the intervals of which are framed, if we may so speak, with arabesques. The ceilings are coffered, and ornamented with paintings, and so pierced, as to afford equal light in every part of the room. The inauguration of this edifice was celebrated by an exhibition, composed of 353 works of Art, and other productions, of which 181 were pictures in all departments of painting; 100 statues, busts, and medals; the remainder consisting of paintings on glass, drawings in chalk and water colour, lithographs, architectural designs, and other productions common to collections of this kind."

"The time cannot be far distant before a periodical exhibition of industrial art will be held in this metropolis, in a building set apart solely for that purpose—we say solely, because, in a manufacturing country of relations and resources so extensive, such an exhibition should be limited to fabrics, manufactures, and art as applied to these without any admixture of fine art. These things originate in the capitals of the continent; but it is probable that London will be behind the provinces in this respect; Manchester has already voted large sums of money for the establishment of a museum, and we doubt not that the same place will shortly have a periodical industrial exhibition, equal in substantial interest to any other in Europe."

ARTISTICAL DECORATION OF PUBLIC ROOMS.

The large room of the Café de l'Europe, in the Haymarket, has been enriched lately by its spirited proprietor, Mr. Hemming, with a series of fine full-length portraits obtained from a palace in Bonn, on the Rhine, which fill the spaces formed by the pilasters that support an entablature running round the room, and, together with some good casts of ancient and modern statuary, give an effect of substantial and tasteful elegance not found in many other coffee-rooms. Anxious to see works of fine art become a necessary part of our houses, we mention the room in question as a good sign and an example worthy of imitation. The portraits include Francis I. of Austria, Charles Alexander of Lorraine, James Edward Stuart, Maria Leckinska, daughter of Stanislaus of Poland, and Louis XV. The majority of them are ascribed to Riego, and two, at least, are very superior works.

Harwich Breakwater. — The new breakwater at Harwich is expected to be commenced in a very short time. A contract for 50,000 tons of Kentish ragstone has been already made.

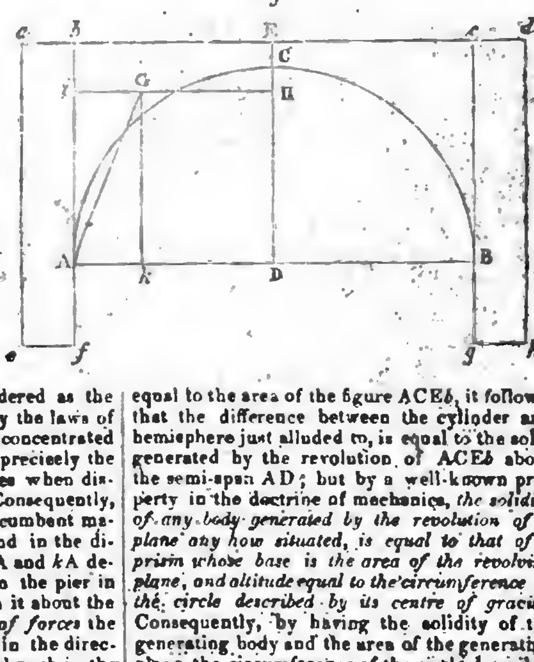
ON THE EQUILIBRIUM OF PIERS.

In the second volume of Dr. Hutton's Course of Mathematics, page 201, third edition, the following proposition is given as an example of the use of the centre of gravity:—

To determine the thickness of a pier necessary to support a given arch.

Now this is a problem of very great utility in *architecture* and the *constructive arts*, and in consequence of its practical importance it is well adapted for the pages of The Builder, which is especially devoted to the discussion of subjects of this nature. The solution of the problem, as given in the volume referred to, is not complete, since it does not shew in what manner the position of the centre of gravity of the balancing materials is found, and this is the very point that constitutes the difficulty by which the practical man is brought to a stand. It is true that the doctrine of the centre of gravity has previously been partially discussed, but no rule is given for determining its position in the case to which the problem refers, and it is for this reason that we have undertaken to reconsider the question, and to put the practical man in possession of a rule, by which the position of the centre of gravity can readily be determined in this and all similar cases. Let ACB, fig. 1, be a semicircular arch, of which AB is the span, DC the versed sine or rise, CE the thickness of the crown, and $abfe$, $cdhg$, the piers by which it is supported.

Fig. 1



Here then it is obvious, that since the arch is symmetrically arranged about its axis DE, and sustained in equilibrio by the two equal piers $abfe$ and $cdhg$, it follows that each pier must sustain one-half the weight of the materials which constitute the arch, so that the mixed figure ACEb is a just representative of the weight, whose action the pier has to resist. Let G be the position of the centre of gravity of the figure ACEb, and from G let fall the perpendiculars Gi and Gk upon the vertical line bf, and the horizontal line AB, and draw the diagonal GA. Now, since G is the position of the centre of gravity of the incumbent weight, it may be considered as the place of that weight; because, by the laws of mechanics, if the whole mass were concentrated in the point G, it would produce precisely the same effect upon the pier as it does when distributed in the form of an arch. Consequently, if Gk denote the weight of the incumbent materials, or the tendency to descend in the direction of gravity; then will GA and kA denote the corresponding effects on the pier in the directions GA and kA to turn it about the point e, for by the *parallelogram of forces* the weight of the semi-arch ACEb, in the direction of gravity Gk, the horizontal push in the direction kA, and the oblique thrust in the direction GA, are to each other as the three sides of the triangle AGk; that is, as the straight lines Gk, kA, and GA.

Taking the force kA, which acts in the direction of the horizon, and considering it to be exerted on the lever Af, its effort to turn the pier about the point e will be expressed by $k\mathrm{A} \times \mathrm{A}f$. Let w denote the whole weight of the semi-arch ACEb, and its effect in the direction kA will be

$$Gk : k\mathrm{A} :: w : \frac{w \cdot k\mathrm{A}}{Gk}$$

The momentum of the semi-arch, or its effort to turn the pier about the point e, is, therefore, expressed by the term $\frac{w \cdot k\mathrm{A} \cdot \mathrm{A}f}{Gk}$, and this must be equal to the momentum of the pier, in order that the arch may be just sustained. Now the weight of the pier is represented by the product of its height and thickness, since it is supposed to be prismoidal, and because the centre of gravity is coincident with the centre of magnitude; the leverage with which it resists the thrust of the arch is equal in length to one-half its thickness; hence the momentum of the pier is expressed by the term $\frac{1}{2}\, bf \cdot ef^2$; consequently, by equating these two expressions, we get

$$\tfrac{1}{2}\, bf \cdot ef^2 = \frac{w \cdot k\mathrm{A} \cdot \mathrm{A}f}{Gk},$$

in which equation ef is the required quantity, all the others being either given or ascertainable by calculation from those that are known. Reducing the above equation in reference to ef, it becomes

$$ef = \sqrt{\frac{2w \cdot k\mathrm{A} \cdot \mathrm{A}f}{bf \cdot Gk}} \ldots\ldots\ldots\ldots (\mathrm{A})$$

If we examine the composition of this equation, it will readily appear, that of the five quantities which it involves, only two of them are known *à priori* from the conditions of the problem, and these are, the leverage Af, and height of the pier bf; the other three quantities of which it consists having each to be determined by an independent process. Now the method of doing this is what the proposed problem does not shew; and although it may not offer any difficulty to the mathematician, yet the case is very different as regards the generality of practical men, the principles on which the omitted parts of the solution depend being to them in nine cases out of ten entirely unknown.

If the rectangular plane AbED, which circumscribes the semi-arch, be supposed to revolve about one of its sides AD, which remains fixed, carrying the quadrant ADC along with it, the rectangular plane will, during its revolution, generate a cylinder whose radius is DE and altitude AD, while the quadrantal plane describes a hemisphere, of which the radius is AD or DC. Now, since the difference between the rectangle AbED and quadrant ADC is equal to the area of the figure ACEb, it follows, that the difference between the cylinder and hemisphere just alluded to, is equal to the solid generated by the revolution of ACEb about the semi-span AD; but by a well-known property in the doctrine of mechanics, *the solidity of any body generated by the revolution of a plane any how situated, is equal to that of a prism whose base is the area of the revolving plane, and altitude equal to the circumference of the circle described by its centre of gravity.* Consequently, by having the solidity of the generating body and the area of the generating plane, the circumference of the circle described by the centre of gravity of the revolving plane can easily be found, and from that the position of the centre of gravity itself becomes assignable.

By the rules of mensuration, the solidity of a cylinder, of which the radius of the base is DE, and altitude AD, is expressed by the term, $3{\cdot}1416 \times \mathrm{AD} \times \mathrm{DE}^2$, and that of a hemisphere, whose radius is AD or DC, is expressed by $2{\cdot}0944\ \mathrm{AD}^3$; consequently, by subtraction, the solidity of the figure generated by the revolution of ACEb, is equal to $3{\cdot}1416 \times \mathrm{AD} \times \mathrm{DE}^2 - 2{\cdot}0944\ \mathrm{AD}^3 = 2{\cdot}0944\ \mathrm{AD}\ (1{\cdot}5\ \mathrm{DE}^2 - \mathrm{AD}^2)$. But the area of the figure by whose revolution this solid is generated, is equal to the difference between the area of the rectangular plane AbED, and that of the quadrantal plane ADC, the former of which is $\mathrm{AD} \times \mathrm{DE}$, and the latter $\cdot 7854\ \mathrm{AD}^2$; hence it is $\mathrm{AD} \times \mathrm{DE} - \cdot 7854\ \mathrm{AD}^2 = \mathrm{AD}\ (\mathrm{DE} - \cdot 7854\ \mathrm{AD})$; therefore, by division, we get

$$\frac{2{\cdot}0944\ \mathrm{AD}\ (1{\cdot}5\ \mathrm{DE}^2 - \mathrm{AD}^2)}{\mathrm{AD}\ (\mathrm{DE} - \cdot 7854\ \mathrm{AD})} = \frac{2{\cdot}0944\ (1{\cdot}5\ \mathrm{DE}^2 - \mathrm{AD}^2)}{(\mathrm{DE} - \cdot 7854\ \mathrm{AD})}.$$

This is the expression for the circumference of the circle, described by the centre of gravity of the figure ACDb, and if this be again divided by 6·2832, we get

$$k\mathrm{G} = \frac{(1{\cdot}5\ \mathrm{DE}^2 - \mathrm{AD}^2)}{3\ (\mathrm{DE} - \cdot 7854\ \mathrm{AD})} \ldots\ldots\ldots\ldots (\mathrm{B})$$

This equation expresses the value of the